

[tex108] Joule cycle

Consider the four steps of the Joule cycle for the classical ideal gas [$pV = Nk_B T$, $C_V = \alpha Nk_B$, $\gamma \doteq C_p/C_V = (\alpha + 1)/\alpha$]. It represents an idealized version of the Escher-Wyss gas turbine.

(a) Calculate the work performance, ΔW , the heat transfer, ΔQ , and the change in internal energy, ΔU , for each step.

1 \rightarrow 2 adiabatic expansion: $S = \text{const.}$

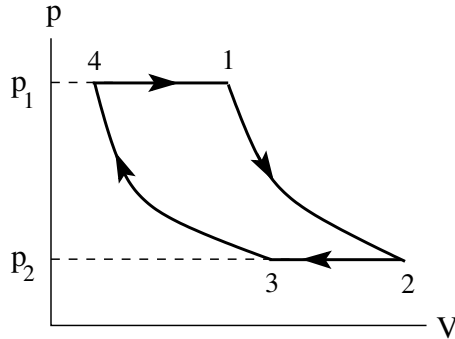
2 \rightarrow 3 isobaric contraction: $p = \text{const.}$

3 \rightarrow 4 adiabatic compression: $S = \text{const.}$

4 \rightarrow 1 isobaric expansion: $p = \text{const.}$

(b) Calculate the efficiency η and express it as a function of the pressure ratio p_2/p_1 .

(c) Sketch the Joule cycle in the (U, S) -plane.



Solution: